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(54) Process and device for injection moulding an object consisting of a number of layers of different materials.

(57) The invention relates to a process for injection moulding of objects consisting of a number of layers of different materials, in which process the different materials ar successively and/or coaxially injected, in plasticated form, into a mould. Before being injected, the different materials are brought into a cavity (7) in the desired order and amounts, with the help of separate injection units (4-6) or by means of a distributor (3), which distributor consists of elementary modules (8-13), each of which is capable of creating a certain combination and configuration of materials in the cavity (7), upon which the contents of the cavity are injected into the mould.

The invention relates also to a device for injection moulding objects consisting of a number of layers of different materials.

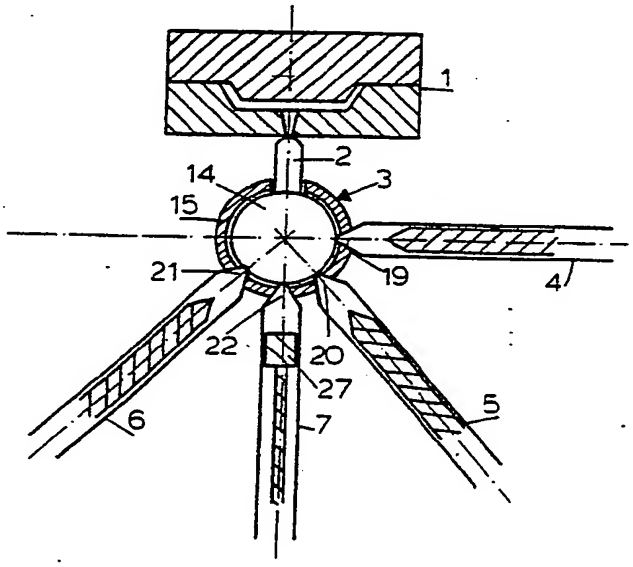

FIG.1

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PROCESS AND DEVICE FOR INJECTION MOULDING AN OBJECT CONSISTING OF A NUMBER OF LAYERS OF DIFFERENT MATERIALS

The invention relates to a process and a device for injection moulding an object consisting of a number of layers of different materials, in which the different materials are successively and/or coaxially injected, in plasticized form, into a mould.

More in particular, the invention relates to injection moulding multilayer thin-walled objects, that is, objects with a wall-thickness which is small with respect to that object's principal dimensions. The total wall-thickness of a large number of the objects referred to is 0.5 - 3.0 mm.

Such a process and device are known from the British patent published under the number 14 75 898.

In the known process different materials are injected into the mould successively from different injection units, which means that, in the injection phase of the mould, the injection units must be opened and closed by means of valves.

In the case of thin-walled objects, the mould must therefore be filled within a very short time, that is, within about one second, dependent on the dimensions of the object, because the relatively cold walls of the mould cause the thin, plastic layer(s) of material to solidify rather quickly. If the material solidifies or hardens too soon (locally), the mould is not filled completely, resulting in a faulty product, which is undesirable.

The aim is therefore to inject the different materials in as short a time as possible.

However, moving valves have a certain inertia and thus set limits to a further reduction of the injection time.

The invention provides a process and a device which do not present the above disadvantage.

The process according to the invention is characterized in that, before being injected, the different materials are brought into a cavity in the desired order and amounts, upon which the contents of the cavity are injected into the mould.

By applying the process according to the invention, a significant reduction in mould filling time is achieved, because the mould is filled from a single injection unit.

The time available for filling the cavity also includes the cooling time (per cycle) and is therefore essentially shorter than the filling or injection time available in the known process. This enables practically any desired layer composition to be realized.

The smaller amount of time required for filling the mould is also an advantage from an economic point of view.

The cavity, or antechamber, can be filled by various extruders during the plasticating phase. In this embodiment relatively simple and, consequently, cheap equipment will suffice, notably: a number of plasticating units and only one injection unit for filling the mould. However, the materials are preferably injected into the cavity after the plasticating phase. This presents the advantage that the layers can be composed with greater accuracy and that the composition is not affected by the plasticating process.

One embodiment of the process according to the invention is characterized in that the materials are brought into the cavity in the desired order and amounts by means of a distributor, which distributor is composed of elementary modules, each capable of creating a certain combination and configuration of materials in the cavity. In this manner the object to be injection moulded can be given a different layer composition in a fairly simple manner, namely by replacing modules.

The said distributor preferably comprises a number of disc-shaped elements provided with radially extending borings, which elements can be positioned with the help of moving devices. By means of a hole or holes in a disc one or more plasticating units and/or injection units can be connected to the cavity (antechamber). Holes may also be applied concentrically along part of their length, to enable coaxial introduction of a number of materials.

The invention also relates to a device for injection moulding objects consisting of a number of layers of different materials, comprising a mould and a number of plasticating units and at least one injection unit. The device known from the already-mentioned British patent GB-A-1475898 comprises a number of independant plasticating/injection units and a number of bodies that can be moved to and fro in chambers, enabling selective connection of the mould to the plasticating units or the injection unit.

The disadvantage of the known device is that the bodies cannot be moved to and fro at an unlimited speed, to keep the injection time as short as possible, because this results in imperfections in the composition (arrangement and amount) of the various material flows. In addition, the known device is technically very complex when three or more (different) materials are to be injection moulded. This disadvantage also applies if a multi-step velocity profile is desired.

The aim of the invention is to provide a device which obviates the above disadvantages at least to an important extent.

The device according to the invention is characterized in that it contains a hollow chamber, which is connected to the plasticating units via a distributor, which chamber is provided with devices for injecting the contents of the chamber into the mould.

By employing a chamber provided with an injection unit, it is possible to fill the mould in a shorter amount of time than has so far been possible.

One embodiment of the device according to the invention is characterized in that the distributor comprises a number of elementary modules, with which each plasticating unit can be connected, either separately or in combination with another unit, to the hollow chamber. In this manner the device can be made suitable for manufacturing a product with other properties, like layer thickness, number of layers, position of a layer in the product, etc. in a relatively simple way, namely by replacing a module

The distributor preferably comprises a number of disc-shaped elements, provided with radially extending borings, which elements are grouped to form an elongated body, which can be moved by means of moving devices and can be fixed in discrete positions. The outer circumference of a disc-shaped element may be shaped like a regular polygon (triangle, quadrangle, etc.) or, preferably, a circle.

The process and device according to the invention are further elucidated in the following with reference to a number of examples and drawings.

In the drawings,

figure 1 is a schematic representation, viewed from above, of an injection moulding machine substantially comprising a mould, a feed channel, a distributor and three plasticating units and an injection unit;

figure 2 is a side-view of the movable elongated body, consisting of bar shaped elements, of the distributor;

figure 3 is a cross section along line 3-3 in figure 2;

figures 4.1 and 4.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 3 layers;

figures 5.1 and 5.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 5 layes;

figures 6.1 and 6.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 9 layers;

figures 7.1 and 7.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 3 layers with an eccentric core layer (on the injection side);

figures 8.1 and 8.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 3 layers with an eccentric core layer (on the sealing side);

figures 9.1 and 9.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 3 layers with an eccentric core layer (on the sealing side), with an improved layer thickness distribution;

figures 10.1 and 10.2 show the layer composition in the antechamber and in the mould, respectively, for a product consisting of 5 layers with an eccentric core layer.

figures 11.1 through 11.6 show the discs used in the distributor.

Figure 1 shows a schematic representation of an injection moulding machine, comprising a mould 1, a feed channel 2, a distributor 3, a first plasticating unit 4, a second plasticating unit 5, a third plasticating unit 6 and an antechamber with an injection unit 7. Instead of the illustrated plunger 27, a screw or a plasticating unit (not shown) may be used, to prevent a long residence time of (residual) material in injection unit 7.

The plasticating units 4, 5 and 6 can be connected, either separately or combined, to antechamber/injection unit 7. Distributor 3 comprises an elongated body 14 (also see fig. 2) consisting of a number of discs 8 through 13 (see firgures 11.1 through 11.6), which shape can be moved to and fro by means of moving devices (not illustrated). Each disc 8 through 13 is provided with its own particular boring. Figure 11.3, for example, shows a disc 10 with three borings 17, 18 and 26, which are concentric along part of their length. The outlets 19, 20, 21 and 22 of plasticating units 4, 5 and 6 and antechamber/injection unit 7, respectively, all lie approximately in the same transverse plane of distributor 3.

Figures 4 through 10 show a number of possible combinations of materials that may be used and their arrangement in the antechamber (this is not intended to be a limitative enumeration). In the figures layer 23 consist of, for example, polypropylene, commercially available under, for instance, the trade name 'Stam P56M10', layer 24 consists of, for example, ethylene vinylalcohol (eval), commercially available under, for instance, the trade name 'Eval EPG', and layer 25 consists of a material that improves the adhesion between polypropylene and eval, for instance, the product available under the trade name 'Admer QF 540'.

Figures 4.1, 5.1, 6.1, 7.1, 8.1, 9.1 and 10.1 may be regarded as longitudinal sections of the contents of

the antechamber.
With the help of the discs positioned specially for that purpose in the plane of outlets 19 through 21, the various materials are successively introduced into the antechamber/injection unit 7 via plasticating units 4, 5 and 6. With the help of disc 13 the contents of the antechamber are finally injected into mould 1 via feed channel 2.

Discs 8 through 13 are preferably dimensioned such that the volume occupied in them by the material to be injection moulded is small with respect to the volume of the mould.

One embodiment of the device according to the invention comprises an antechamber which is positioned between the feed channel and the distributor (not illustrated). This presents the advantage that the volume of the residual material remaining after injection from the antechamber into the mould is minimal.

Claims

1. Process for injection moulding an object consisting of a number of layers of different materials, in which process the different materials are successively and/or coaxially injected, in plasticated form, into a mould, characterized in that, before being injected, the different materials are brought into a cavity in the desired order and amounts, upon which the contents of the cavity are injected into the mould.

2. Process according to claim 1, characterized in that the materials are brought into the cavity with the help of separate injection units.

3. Process according to claim 1 or 2, characterized in that the materials are brought into the cavity, in the desired order and amounts, by means of a distributor, which distributor consists of elementary modules, each of which is capable of creating a certain combination and configuration of materials in the cavity.

4. Process according to claim 3, characterized in that the distributor comprises disc-shaped elements provided with a number of radially extending borings, which elements can be positioned by means of moving devices.

5. Device for injection moulding objects consisting of a number of layers of different materials, comprising a mould and a number of plasticating units, characterized in that use is made of a hollow chamber which is connected to the plasticating units via a distributor, which chamber is provided with means for injecting the contents of the chamber into the mould.

6. Device according to claim 5, characterized in that the distributor comprises a number of elementary modules, with which each plasticating unit can be connected separately to the hollow chamber.

7. Device according to claim 5 or 6, characterized in that the distributor comprises a number of disc-shaped elements provided with radially extending borings, which elements are grouped to form an elongated body, which can be moved by means of moving devices and can be fixed in discrete positions.

8. Process, substantially as described and elucidated with reference to the examples.

8. Device, substantially as described and elucidated with reference to the examples.

10. Product obtained with the process according to any one of claims 1-4 or with the device according to any one of claims 5-7.

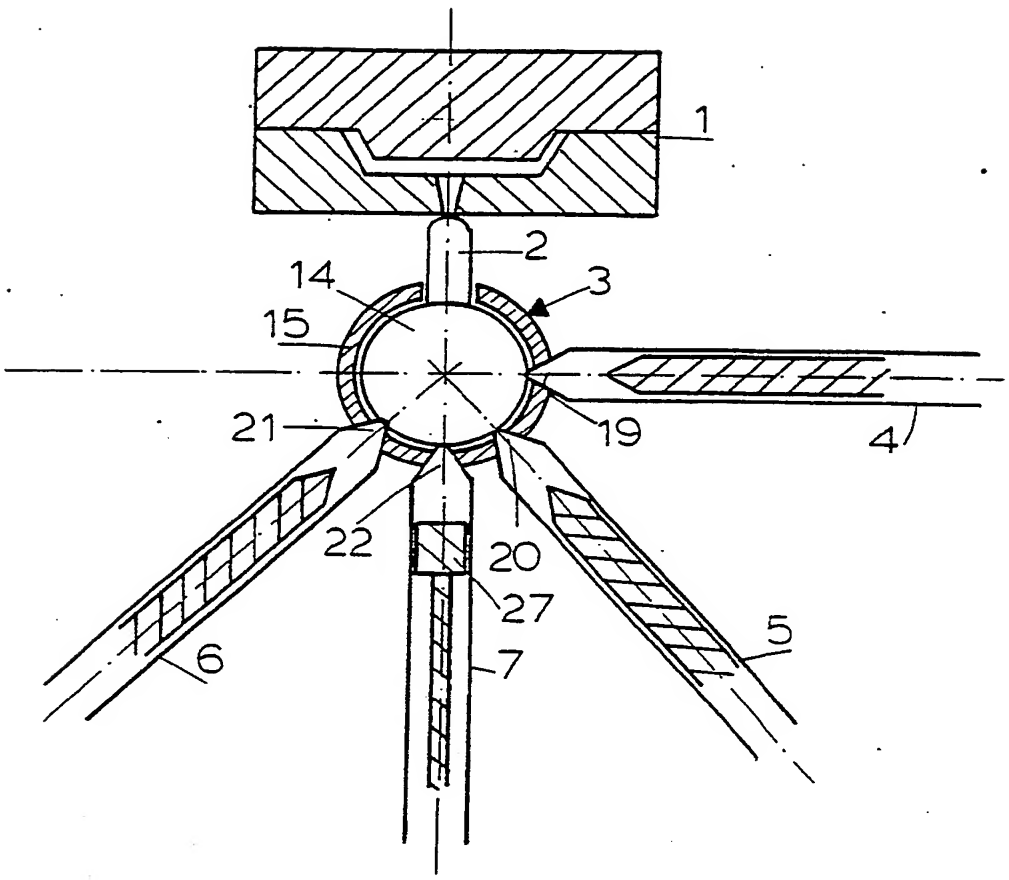

FIG. 1

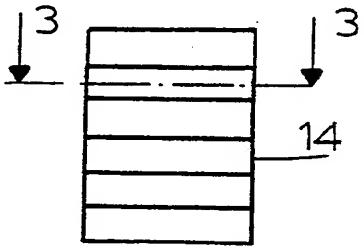

FIG. 2

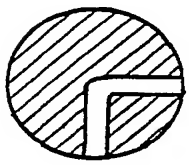

FIG. 3

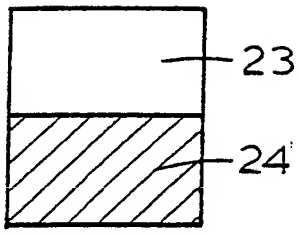

FIG.4.1

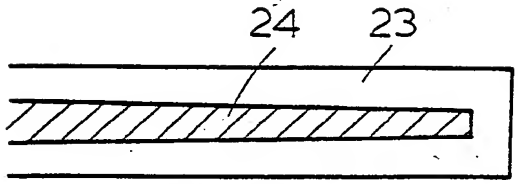

FIG.4.2

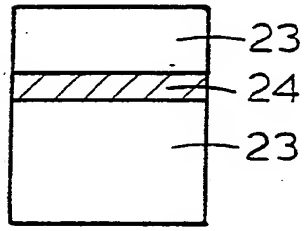

FIG.5.1

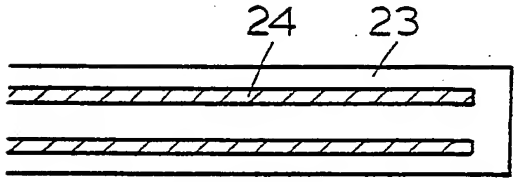

FIG.5.2

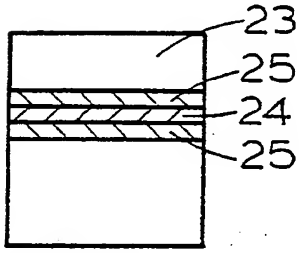

FIG.6.1

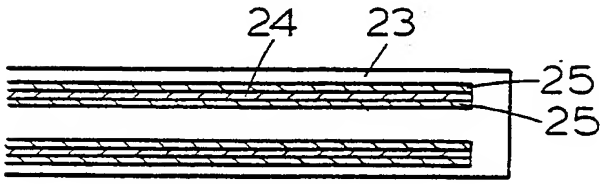

FIG.6.2

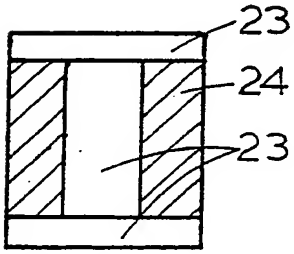

FIG.7.1

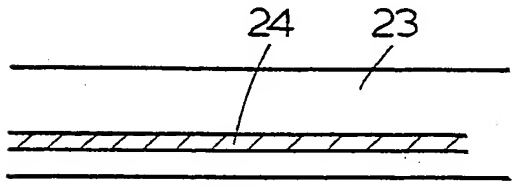

FIG.7.2

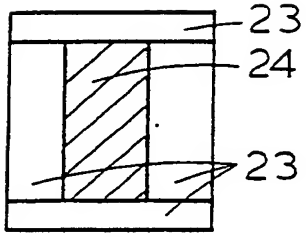

FIG. 8.1

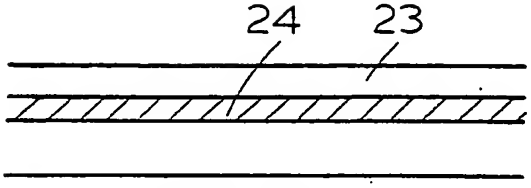

FIG. 8.2

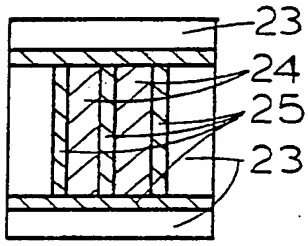

FIG. 10.1

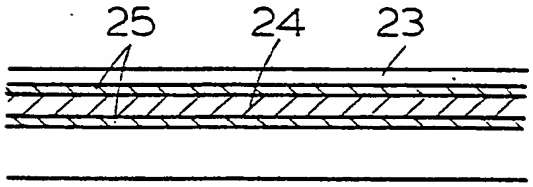

FIG. 10.2

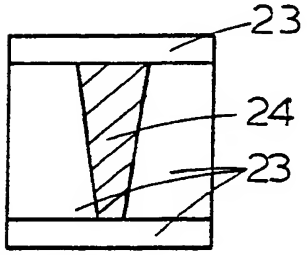

FIG. 9.1

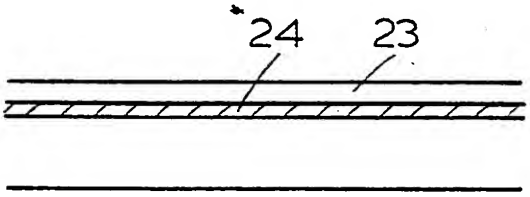

FIG. 9.2

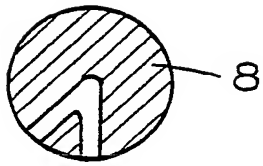

FIG.11.1

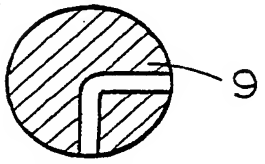

FIG.11.2

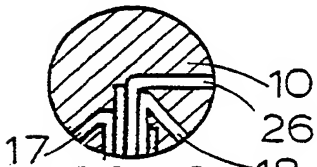

FIG.11.3

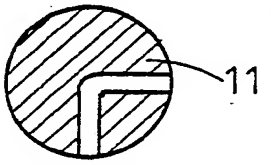

FIG.11.4

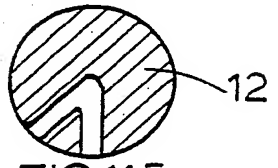

FIG.11.5

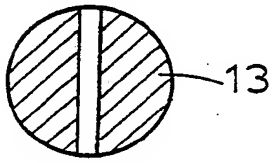

FIG.11.6

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EUROPEAN SEARCH REPORT

Application number

EP 87 20 1362

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-2 411 808 (RHONE-PROGIL) * Whole document *	1,8,10	B 29 C 45/16
Y		5,9	
X	FR-A-2 204 499 (IMPERIAL CHEMICAL INDUSTRIES) * Whole document *	1,2,8, 10	
Y		5,9	
X	WO-A-8 201 160 (GARDEN CONTAINERS) * Whole document *	1,2,8, 10	
Y		5,9	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A		3	B 29 C
X	FR-A-1 367 935 (OFFICINE MECCANICHE NEGRI BOSSI) * Whole document *	1,2,8, 10	
Y		5,9	
X	US-A-4 029 841 (SCHMIDT) * Whole document *	1,8,10	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-10-1987	BOLLEN J.A.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application number

EP 87 20 1362

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	---	5,9	

			TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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